ART. XXI.—*A History of the Discovery of the Circulation of the Blood.* By P. FLOURENS; Perpetual Secretary of the Academy of Sciences (Institute of France); Member of the Royal Societies and Academies of Science of London, Edinburgh, Stockholm, Munich, Turin, Madrid, Brussels, etc. Professor at the Museum of Natural History at Paris. Translated from the French by J. C. REEVE, M. D. Cincinnati: Rickey, Mallory and Company, 1859. 12mo. pp. 178.

IT is well known that all great discoveries are made but slowly. No one, indeed, can study the rise and progress of any of the inductive sciences without being struck with the fact that such discoveries are not sudden additions to the common stock of knowledge made by a single observer, but are, in reality, the slowly matured results of the patient labours of many individuals who have toiled diligently at different epochs of time, perhaps, and in different countries. Years of patient drudgery are required for the discovery of facts. These facts are recorded and oftentimes forgotten, to be rediscovered and again recorded as new. For a long time their true value and relations are not perceived. They are looked upon as isolated details having no necessary connection. From time to time, however, as the details become more and more numerous, attempts are made to classify and reduce them to some definite order. Such attempts gradually prepare the way for the recognition of the great discovery which is to coordinate these details and to stamp them with their exact value. As the fulness of time approaches, and men begin to attach a deeper significance to the slowly accumulating facts, it often happens that different individuals in various parts of the world, are, unknown to each other, working out the same idea, or hopefully pursuing the same line of inquiry. Occasionally they catch rude and uncertain glimpses of the truth which is afterwards to startle the world, but the data for the generalization towards which they are tending not being complete, they never comprehend that truth, their eyes are not blessed with beholding the discovery. At length the discoverer appears; the man who, with comprehensive mind, grasps the details worked out by his predecessors, supplies by his own investigations the deficient data, and rising above the facts, seizes, as if suddenly and by inspiration, the great truth for which the world was waiting. Thus the discoverer stamps with the seal of his own name the labors of all those who preceded him in the particular field of his research.

Such is the history of the discovery of the law of gravitation; such the history of the discovery of the cell doctrine—the fundamental theory of statical physiology; and such the history of the discovery of the circulation of the blood—a discovery which marks a new era in the science of physiology, and therefore in that of medicine. This discovery was not a sudden performance effected without preparation by a solitary observer, in a happy moment of inspiration, but the gradual, and we may say, anticipated result of the patient and long-continued observations, the judicious experiments and careful generalizations of many thinkers and observers.

The inception of a great discovery is generally preceded by the exposure and overthrow of prevalent and more or less firmly established errors. This was especially the case with the discovery of the circulation. According to our author, three principal errors masked the important fact of the circulation of the blood. The first was that the arteries contained air only; the second, that the septum between the two ventricles of the heart was perforated; and the third, that the veins carried the blood to the extremities instead of bringing it from them to the heart.

A moment's reflection will show that the discovery of the circulation was an impossibility so long as such erroneous notions were maintained by anatomists and physiologists. To Galen belongs the lasting honor of demonstrating that the arteries contain blood and not air. Vesalius, the father of modern anatomy, overthrew the notion of a perforated ventricular septum. Servetus showed that the veins carried blood to the heart, and not away from that organ. These three illustrious observers are justly to be regarded, therefore, as the pioneers of the important discovery under consideration.

Erasistratus maintained that the arteries are filled with air. He taught that air entered the lungs by the trachea; from the trachea it passed into the pulmonary vein, thence into the left ventricle and the arteries, and by the latter was distributed to the system. As long as the teachings of this ancient philosopher were implicitly accredited, as long as one part of the vascular apparatus was regarded as a channel for air, and another part a channel for blood, the conception of the true idea of the circulation was an impossibility.

Galen observing that blood always escapes, when an artery is opened, concluded that the blood was either contained in the artery, or flowed into it from some other part of the body. He thought that the latter supposition could not be true, for if the artery contained nothing but air, the air should escape before the blood. This he saw was not the case. He noticed that blood alone issued from a punctured artery. He ligated an artery in two places, and opening the vessel between the ligatures, found nothing but blood therein. Thus, by observation, experiment, and reflection of the simplest character, Galen overturned the first of the three ancient hypotheses which for so long a time had interfered with the discovery of the circulation.

> "Thus then," writes Flourens, "it was established that the arteries do not contain air; they contain only blood like the veins; an entire half of the sanguineous system, which had been detached by an hypothesis, was given back to it again; and, as the circulation is but the unceasing movement of the blood from the heart into the arteries, and from the arteries into the veins, and through the veins back again to the heart, so long as the arteries were supposed to contain nothing but air the discovery of the circulation was impossible; without the first step which Galen made, it was impossible to make a second.
>
> "Of the three principal errors, then, first mentioned, there was one less; one was destroyed. But Galen was not so happy with the two others. He still believed that the septum between the two ventricles was perforated, and that the veins carried the blood to the extremities; two errors which were destined to pass from him to the moderns, and the latter of which is opposed to the very idea of the circulation."

As the result of his own observations and experiments, Galen believed and taught that there were two kinds of blood—the *spiritual* or arterial blood contained in the arteries and left ventricle, and the *venous* blood filling the veins and right side of the heart. The spiritual blood, he thought, nourished organs of light and delicate texture, such as the lungs; the venous blood nourished those heavy and gross, such as the liver. The nutritive power of the venous blood was derived from the *spirit* mixed with it, and this spirit, the purest part of the blood, was generated, according to Galen, in the left ventricle. Entertaining such views, and believing, moreover, that in both the veins and arteries the stream of blood flowed away from the heart to the extremities, Galen was forced very naturally to adopt the erroneous notion of a perforated ventricular septum. For by this hypothesis only could he account for the mixture of the *spirit* contained in the left ventricle, with the venous blood filling the right. Galen, therefore, held the septum to be perforated because he had imagined a system which rendered a communication between the ventricles necessary. Mondini, Vasseus or Le Vasseur, and many others of the early modern anatomists, blindly adopted the opinion of Galen. At length, in 1521, Berenger de Carpi doubted, and, in 1555, Vesalius finally denied, positively, the existence of interventricular openings, and thus removed the second great error which opposed the discovery of the circulation. At this juncture appeared Michael Servetus, the discoverer of the pulmonary or lesser circulation, and the victim of Calvanistic bigotry and fury. At his advent it was generally known that the arteries as well as the veins are filled with blood, that these two sets of vessels contained different kinds of blood, and that the partition between the ventricles was not perforated. All this was essentially preparatory to the discovery of the pulmonary circulation. It was still believed, however, that the veins, like the arteries, conveyed blood from the heart. This remaining error had yet to be overthrown. For its overthrow we are indebted to Servetus, who, though at first educated as a physician, afterwards became a divine, and wrote a work entitled *The Restitution of Christianity*, a most remarkable compound of theology, metaphysics, and physiology. A copy of this extraordinary volume, the only copy perhaps in existence, is contained in the library of the French Institute. Curiously enough it is the very copy which once belonged to Colladon, one of the accusers raised up by the pitiless Calvin against the unfortunate Servetus. The passages upon which are based the accusations against Servetus are underscored in this copy by Colladon himself. A frightful souvenir, as Flourens calls it, of this unlucky volume is the scorched and blackened appearance exhibited by several of the pages. It appears to have been saved from the pile where author and work were burnt together, only after the conflagration had commenced.[1] In this theologico-physiological treatise occurs that remarkable paragraph concerning the pulmonary circulation which has given rise to so much discussion, and which, more than anything else, more than his sad fate even, has preserved his name from oblivion.

---

[1] A reprint of the *Christianismi Restitutio* appeared in 1790, in which the first edition is reproduced as far as the 734th page. A copy of this work was bequeathed by a Dr. Sims to Dr. George Sigmond, author of a work entitled *Unnoticed Theories of Servetus.* To that copy the following note was prefixed: "The fate of this work has been not a little singular. All the copies except one were burned along with their author, by the implacable Calvin. This copy was secreted and saved by D. Colladon, one of the judges. After passing through the library of the Landgrave of Hesse Cassel it came into the hands of the celebrated Dr. Mead, of London, who endeavoured to publish a quarto edition of it; but before this edition was nearly completed, it was seized on the 27th of May, 1723, at the instance of Dr. Gibson, Bishop of London, and burned—a very few copies excepted. The late Duke de Valliere gave near 400 guineas for this copy; and at his sale it brought 3810 livres." According to Flourens, Mead gave it to Boza, and subsequently it was purchased for the Royal Library at Paris, for a very high price. (See an interesting brochure entitled, *Calvin and Servetus: the Reformers' share in the Trial of Michael Servetus Historically Ascertained*, translated from the French of A. Rilliet, by the Rev. W. K. Tweedie, Edinburgh and London, 1846, p. 68.)

> "This communication," writes Servetus (*i. e.* the passage of the blood from the right to the left ventricle), "takes place not by the middle septum of the heart, as is generally believed, but by a remarkable artifice; the subtle blood of the right side of the heart is agitated in a lengthened course through the lungs, whereby it is elaborated, from which it is thrown of a crimson colour, and from the vena arteriosa (pulmonary artery) is transfused into the arteria venosa (pulmonary veins); it is then mixed in the arteria venosa itself with the inspired air, and by the act of expiration is purified from fuliginous vapors, when, having become the fit recipient of the vital spirit, it is at length attracted by the diastole."[1]

From passages in the writings of Galen[2] and Vesalius,[3] we may conclude that both these illustrious men had some vague idea of the fact that the blood of the right ventricle passed, at least in part, through the pulmonary artery into the lungs. But, as Flourens very justly observes—

> "This was only the half of the truth. The entire and complete idea necessary to establish the pulmonary circulation was to understand that the blood passed from the *pulmonary artery* into the *pulmonary veins;* that the blood leaving the right heart by the pulmonary artery, returned to the left heart by the pulmonary veins; that the blood left the heart and returned to the heart; that there was, consequently, a *circuit, circulation;* and this idea of the circulation, so grand and so new, was first formed by Servetus."
>
> "Now," continues Servetus, "that the communication and preparation take place as stated through the lungs, is proclaimed by the various conjunctions and communications of the arterial vein with the venous artery. The remarkable size of the arterial vein (pulmonary artery) confirms this, a vessel which could neither have its actual constitution nor dimensions, nor transmit such a quantity of the purest blood direct from the heart itself for the mere nourishment of the lungs. Neither would the heart supply the lungs in such proportion (especially when we see the lungs in the embryo nourished from another source), by reason of those membranes or valves which remain unopened until the hour of birth, as Galen teaches. The blood, consequently from the moment of birth, is sent, and in such quantity is sent, for another purpose from the heart into the lungs; from the lungs also it is not simple air that is sent to the heart, but air mixed with blood is transmitted through the arteria venosa (pulmonary vein). In the lungs consequently does the mixture take place. The crimson colour is imparted to the spirituous blood by the lungs, not by the heart. There is not room enough in the left ventricle of the heart for so important and so great an admixture; neither is there space there for the elaboration into the crimson colour. Finally, the septum medium, seeing that it is without vessels and properties, is not adapted to accomplish that communication and elaboration, although something may transude through it."
>
> "All this," observes Flourens, "is full of sagacity, acuteness, and penetration. The connection or union of the pulmonary artery with the pulmonary vein in the lungs by an infinite number of branches; the calibre of the pulmonary artery, which would be much too large if it served only for the nutrition of the lungs; the nutrition of this organ in the embryo without the blood of the pulmonary artery, which, indeed, does not then transmit any; all these are most excellent and decisive reasons—the same which we now give—the true ones."

To Servetus belongs another honour. He not only discovered the true route of the blood from one side of the heart to the other through the lungs, but he also discovered the true place of *sanguification*, of the *transformation* of the blood, of its change from black blood to red. Galen placed the seat of sanguification in the liver; Servetus first located it in the lungs; a truth which was not then remarked, which was not comprehended until long afterwards, and which, indeed, did not receive its full development until very recent times by the experiments of Goodwyn and Bichat.

---

[1] Christianismi Restitutio. Viennæ Allobrogum, 1553.

[2] De Hippocratis et Platonis decret., vi. 264.

[3] Opera Omnia Anat., 1725, i. 517.

> "The passage of the blood from one ventricle into the other," continues Servetus, "is not through the septum. In the same manner that the blood of the *vena porta* passes into the *vena cava* through the liver, so the blood of the arterial vein passes into the venous artery through the lungs." A nearer approach to the truth could not have been made without finding it. Finally, said Servetus, in closing, and he could safely say it, "if any one will compare these things with what Galen has written in the sixth and seventh books of his work, *De Usu Partium*, he will see clearly the truth which Galen did not perceive."

Six years later, Realdo Columbus, whom Flourens regards as one of the best of the early Paduan anatomists, discovered again and independently the pulmonary circulation. He appears to have been unacquainted with the labours of Servetus, yet we find in his work, *De Re Anatomica*, published in 1559, the following remarkable passage:—

> "Between the two ventricles is the septum through which it is believed the blood passes from the right to the left; but this is a great mistake, for the blood is carried by the arterial vein into the lungs, thence it passes with the air by the venous artery into the left ventricle of the heart."

He reasons upon the valves of the heart in very much the same manner as did Harvey, nearly seventy years afterwards. The blood, he says, when it has once entered the right ventricle from the vena cava, can in no way get back again; for the tricuspid valves are so placed that, whilst they give a ready passage to the stream inwards, they effectually oppose its return. The blood continues to advance from the right ventricle into the vena arteriosa or pulmonary artery; once there it cannot flow back upon the ventricle, for it is opposed by the sigmoid valves situate at the root of the vessel. The blood, therefore, agitated and mixed with the air in the lungs, and, having thus in some sort acquired the nature of spirit, is carried by the arteria venosa or pulmonary vein into the left ventricle, whence, being received into the aorta, it is, by the ramifications of this vessel, transmitted to all parts of the body.

Notwithstanding the accuracy of the above language concerning the course of the blood, we have only to turn to other portions of his writings to learn that Columbus could never have entertained the true Harveian notion of the circulation. He denies the muscular character of the heart, and thinks, with Galen, that all the veins of the body originate in the liver; that the portal vein arises by innumerable roots from the concavity of the liver; and that the vena cava and its branches originate from the convexity of this organ, and carry the blood that is requisite to nourish and maintain every part of the body.

Next in the chronological order comes Andreas Cæsalpinus, of Arezzo, who, without referring to Columbus, also describes the pulmonary or lesser circulation in the subjoined words:—

> "This circulation which carries the blood from the right heart through the lung into the left corresponds perfectly with the disposition of the parts. For each ventricle has two vessels, one by which the blood arrives, and the other by

which it departs. The vessel by which the blood arrives at the right ventricle is the vena cava, that by which it leaves is the pulmonary artery. The vessels which pour the blood into the left ventricle are the pulmonary veins, the vessel which affords its exit is the aorta."[1]

Cæsalpinus appears to have been the first to use the word *circulation;* and the language which he employs in several parts of his work, indicates some knowledge of the general or systemic, as well as the lesser or pulmonic circulation.

> "He was the first," according to Flourens, "and the only one before Harvey, who called attention to the swelling of the veins which takes place *below* and never *above* the ligature. It is a very curious thing, he observes, that the veins become distended below the ligature and not above it. Those who bleed patients, he adds, are familiar with the fact; they always place the ligature *above* the place of puncture and not *below* it: *quaia tument venæ ultrâ vinculum non citrâ;* which should be just the contrary if the movement of the blood was from the heart towards the external parts of the body."

In another place he says:—

> "The blood conducted to the heart by the veins, receives there its perfection, and this perfection acquired, it is carried by the arteries to all parts of the body."

Flourens observes that a better conception of the general circulation could not be found, nor a better definition be given in as short a sentence.

We are constrained to differ from the critical estimate which M. Flourens is disposed to place upon the views of Cæsalpinus concerning the circulation. This celebrated peripatetic philosopher appears to have had no conception of the heart as the efficient cause of any motion which the blood might have; he was ignorant of the existence of the valves of the veins; in different parts of his work he still speaks of the permeation of the septum ventriculorum by the blood; and he says that the swelling which takes place in the veins of an extremity beyond a ligature is due to the effort made by the blood to get back to the focus or centre, lest, through the compression of the veins, it should be cut off and suffocated. He speaks, it is true, of the intercommunication of the minute arteries and veins, but adds that it is only during sleep that the blood passes from the former into the latter class of vessels; for it is during sleep, he thinks, that the veins become distended, whilst the pulsations of the arteries are then moderated. As has been observed by Dr. Willis, the translator of Harvey's works,

> "He plainly sees no connection between a delivery by the artery and a filling by the vein. It is along with all this, and as if to settle the question of the kind of knowledge Cæsalpinus had of the movement of the blood, that he uses the old word Euripus, to express his idea of its alternating or tide-like motion."

Entertaining such notions, it is evident that his conception of the circulation as a whole must have been very confused and unsatisfactory.

Cæsalpinus, however, was undoubtedly a man of broad and comprehensive views. He was in advance of his contemporaries not only in his ideas concerning the circulation, but also in his views of natural classification. He compared and classified plants, not according to their external characters, as was then the custom of botanists, but with reference to their organs of fructification, their flowers, fruits, and grains. In so doing he anticipated, to a certain extent, Cuvier's great discovery of those fundamental laws of comparative anatomy, the correlation or harmonization of organs, and the subordination of parts. It was in 1583, in his work, *De Plantis*, that Cæsalpinus announced his new method of classification based upon organism. More than two hundred years later Cuvier carried this methodological principle into the Règne Animal, and used it in the most masterly manner in his unwearied attempts at the exact classification of animals. We are indebted to Flourens for an admirable "*History of Cuvier and his Scientific Labours.*" In that work he dwells with enthusiasm upon the extensive and philosophical use which Cuvier made of the above mentioned laws of organization. He speaks of the application of these laws by Bernard and Jussieu in the vegetable kingdom, but, unaccountably enough, makes no allusion to the early and sagacious recognition of these laws by Cæsalpinus.

---

[1] Quæstionum Peripateticarum. Venise, 1593, v. 125.

The next step towards the establishment of a full and complete knowledge of the circulation, was the discovery of the valves of the veins, made in 1574, by Fabricius ab Acquapendente.

> "Fabricius saw well that the valves open towards the heart. They oppose, therefore, any passage of the blood from the heart to the external parts in the *veins ;* it must go then from the parts towards the heart—the reverse of what takes place in the arteries, which have no valves. The valves of the veins are the anatomical proof of the circulation—the proof that it makes a circuit, that it returns upon itself, that it circulates. But Fabricius did not understand this proof; he saw the fact, but failed to draw from it that important deduction which was left for the genius of Harvey. He believed that the only use of the valves was to prevent too great an accumulation of blood in the inferior parts of the body, an occurrence which would be attended with the double inconvenience of too great a supply to the lower parts, and too small a quantity in the upper."

Gassendi, in his *Vita Peyreschii*, says that the discovery of the valves of the veins was really made by an Italian writer named Sarpi, who confided it to Fabricius. But of this statement, Flourens concludes with Tiraboschi, the historian of Italian literature, more and other proof must be furnished, before it can be considered established.

M. Portal, in his *Histoire de l'Anatomie*, says that Vasseus or Le Vasseur, a disciple of Jacques Sylvius, and the author of a small Latin abridgment of the anatomy and physiology of Galen, "knew almost as much as we do of the circulation of the blood." But a passage which Flourens quotes from his writings is sufficient to show that he knew nothing of the circulation, not even of that which goes on through the lungs.

Passing over the claims, therefore, of Sarpi, Le Vasseur, and others, we come at length to the illustrious Harvey.

> "When Harvey appeared," writes our author. "everything relative to the circulation of the blood had been indicated or suspected; nothing had been established; and this is so true, that Fabricius, who comes after Cæsalpinus, and who discovered the valves of the veins, knew nothing of the circulation. Cæsalpinus himself, who so plainly perceived the two circulations, mixed with the idea of the pulmonary circulation the error of a perforated septum. *Sanguis partim per medium septum, partim per medios pulmones* * * * * *ex dextro in sinistrum ventriculum cordis transmittitur.* Servetus said nothing of the general circulation. Columbus repeated, after Galen, the fictions of the origin of the veins in the liver, and the transmission of blood to the extremities by them."

---

[1] De Venarum Ostiolis; Hieron. Fab. ab Acquapendente Opera Omnia Anatomica, 1737, p. 150.

Harvey was thoroughly acquainted with all that had been done before his time for the anatomy and physiology of the circulation. In his *Exercitatio Anatomica de motu cordis et Sanguinis*, he quotes Fabricius and Columbus. He was educated, moreover, at Padua where the state of the question was fully understood, and where everything which had been said upon the circulation was known by all. His work is indeed a masterpiece. Flourens, always positive and always enthusiastic, says, that "this little book of a hundred pages is the most beautiful volume on physiology." Harvey commenced his labours by studying the movements of the heart. He observed in the first place that the contraction of the auricles was not synchronous with, but was followed immediately by the contraction of the ventricles. He saw that the systole of the right auricle had the effect of driving the blood into the right ventricle; that the contraction of the latter forced it into the pulmonary artery which carried it into the lungs and delivered it to the pulmonary veins, whence it was poured into the left auricle. He saw, furthermore, that the contraction of the left auricle drove the blood into the corresponding ventricle; that the systole of the latter caused the blood to pass into the aorta by which it was distributed to all the arteries of the body. From the arteries he suspected that the blood must be transferred to the veins, for it could not well return upon itself. He saw, indeed, that the blood of the two venæ cavæ flowed into the right auricle every time the latter was dilated. He examined the valves of the heart and of the great vessels at its base, and saw from their position and construction that they permitted the blood to flow in one direction only. Then he examined the arteries, and observed that when an artery was opened the blood escaped in unequal jets, alternately stronger and feebler; and that the stronger jets always corresponded with the diastole of the artery and not with the systole. He concluded, therefore, that it was the impulse, the shock of the blood which distended the artery and caused it to beat. For if the artery dilated of its own inherent power it could not expel the blood with the greatest force at the moment of greatest dilatation. In this conclusion he was confirmed by a case of ossification of the femoral artery which fell under his observation. The artery pulsated below the ossified portion. Harvey next directed his attention to the veins. He examined the valves of these vessels, and drew from them the important deduction which had escaped their discoverer, his master Fabricius. He saw that they permitted the blood to flow towards the heart and in no other direction. He argued therefore that the venous blood flowed from the extremities to the heart. Finally he resorted to experiment. His experiments were few, but decisive; and in this, as Flourens justly remarks, is shown his genius.

"When a ligature is tied tightly around an extremity the blood is arrested in the veins alone, because they alone are superficial; when the ligature is tied tightly the blood is also stopped in the arteries which lie deeper. When a vein is tied the swelling takes place *below* the ligature; when an artery is tied it takes place *above*; the blood then flows in directly opposite directions in the arteries and veins; it flows from the extremities to the heart in the latter, and from the heart to the extremities in the former. When any artery whatever is opened, and the blood allowed to flow freely, all the blood of the body is lost through this opening; then all parts of the circulating system communicate with one another, heart, arteries and veins. A moment's reflection, in truth, upon the marvellous rapidity of the movement of the blood will convince one that it must necessarily be thus; for scarcely has the blood arrived at the heart when it leaves it and enters the arteries, no sooner has it entered them than it commences to

> pass into the veins, and from the veins it goes immediately into the heart again; this course, this continual *return*, is the circulation."

Such were the observations, such the experiments, and such the logical reasoning with which Harvey worked out the great physiological problem of the circulation of the blood. With him the doctrine of the circulation was not a sensible demonstration, but a profoundly logical inference or induction from various anatomical facts which, when rightly interpreted, showed that the passage of the blood from the arteries into the veins, and from the veins into the arteries, was a necessary movement. Harvey never beheld the passage of the blood from the arteries to the veins. He appears to have had no idea of an intermediate or capillary network. For the demonstration of such a vascular rete the microscope was necessary, and the intelligent application of this instrument, or rather of magnifying powers of the rudest description, to the study of anatomical structure, cannot, it appears, be traced further back than the time of Malpighi and Leuwenhoek. It is a curious fact that Malpighi, the demonstrator of the capillary system, was born in the very year in which Harvey's work on the heart was published. The microscopic researches of the eminent Bolognese on the blood-corpuscles, published in 1686, were among the earliest of those numerous and laborious investigations which led ultimately to the announcement by Schwann of the cell doctrine in 1838.

In the chapter devoted to "Sarpi and the Valves of the Veins," Flourens thus sums up his opinion of Harvey's claims as the discoverer of the circulation:—

> "I have already said that the discovery of the circulation of the blood does not belong to any single man. This grand discovery was only made little by little, and part by part; more than twenty anatomists took part in it.
>
> "Harvey demonstrated the circulation of the blood; but he came from Padua, where Fabricius, who had discovered the valves of the veins, was his teacher; in this same University of Padua, where were formed the germs of all Harvey's ideas, Realdo Columbus, who discovered the pulmonary circulation, was but a short time before professor; and Padua is not far from Pisa, where Cæsaalpinus, by the light of genius, caught sight of the pulmonary circulation, and by a brighter flash of the same divine fire saw the general circulation.
>
> "In the discovery of the circulation the point of difficulty was to unite the diverse observations successively made, or, so to speak, the different pieces into one whole; the difficulty was to comprehend the phenomena, and the whole of the mechanism united together; and it is because Harvey was the first who clearly and completely comprehended this whole that the glory has remained his."

From this language it will be seen that Flourens follows the beaten track of criticism in simply coupling the name of Harvey with the enunciation of the ultimate fact of the discovery of the circulation. Notwithstanding the preparation that had been made for this discovery, two prevalent errors still stood in the way of its complete development. These errors were rectified by Harvey. When this illustrious man took up the study of the circulation, the heart was regarded as a passive receptacle for the blood, a reservoir in which blood was generated and spirits elaborated. Harvey recognized in the heart an active propelling agent driving the blood out through the pulmonary artery and aorta. This activity he demonstrated by his experiments upon the living animal. The very first chapter in his essay is devoted to the consideration of the movements of the heart, and the title of his treatise, it will be observed, is "*Excitatio de Motu Cordis* *et Sanguinis,"* not *de Motu Sanguinis et Cordis.* In regarding the heart as an agent by which the circulation of the blood is accomplished, Harvey was decidedly in advance of his contemporaries. He was ahead of them in another particular also. They believed the blood of the veins to be essentially different from that of the arteries. They could not be convinced, as Harvey was, that the two bloods were in reality one and the same, and that the difference in colour was due to changes wrought in the arterial blood as it passed through the body from the arteries into the veins. Even after Harvey had published his views we find Joannes Veslingius,[1] then professor in the University of Padua, and one of the most profound anatomists of his age, addressing two letters to him and urging among other objections to the new doctrine the notable difference between the colour of the arterial and venous blood. To Veslingius it seemed impossible that the dark-coloured fluid found in the veins could be the same as the bright scarlet blood of the arteries.

To the anatomical and physiological facts discovered by his predecessors, Harvey, as the result of his own observations, added a physiology of the cardiac movements so complete and satisfactory in all its details that it remains to this day, like the subsequent experiments of Hales upon the circulation, a model of research. In Harvey were happily combined the two elements of the great discoverer. His perceptive or observational powers were excellent, and he exhibited the generalizing or inductive faculty in its most eminent degree. A good observer, he was still a better generalizer. His mind, indeed, was remarkably assimilative and logical.

> "The facts he used were familiarly known, most of them to his predecessors for nearly a century, all of them to his teachers and immediate contemporaries; yet did no one, mastering these facts in their connection and sequence, rising superior to prejudice, groundless hypothesis, and erroneous reasoning, draw the inference that now meets the world as irresistible until the combining mind of Harvey gave it shape and utterance."

M. Flourens' *History of the Discovery of the Circulation* is a most admirably drawn and deeply interesting treatise. The style in which it is written—the *style coupé* of rhetoricians—is remarkable for its clearness and conciseness, and for its spirited and lively effect upon the mind of the reader. The facts are chosen with care and discrimination, and the different steps of the discovery are exhibited in an order at once logical and chronological. The circulation of the adult is discussed in the first chapter. The second is devoted to the fœtal circulation. The third is occupied with an account of the discovery of the lacteals, the receptaculum chyli, and the lymphatics. In the fourth chapter are considered the claims of Sarpi as the discoverer of the valves of the veins. In Chapter V. our author treats of "Servetus and the formation of the spirits." Chapters VI. and VII. contain an account of the contest between ancient and modern physiology, together with some notice of the doings of the "Faculty of Paris," and of the doings and sayings of the eccentric Guy-Patin, the French representative, *par excellence,* of the Greek and Latin epoch in medicine, or, as Flourens calls it, the erudite period of French medicine.

M. Flourens writes *con amore,* and with a degree of enthusiasm only equalled by his philosophical discrimination. He causes facts and their observers, discoveries and their discoverers, to pass before us as in a moving panorama. His critical estimate of these, though not invariably correct, is in the main just and to the point. Though we read the French copy of his treatise when it first appeared in 1854, with a lively and absorbing interest, we have read the translation before us with a pleasure in nowise abated by our familiarity with its contents. This translation we have compared with the original text, and find it to be an accurate and reliable rendering of the French. Dr. Reeve has happily and skilfully preserved the spirited and vivacious style of the author. J. A. M.

---

[1] Observationes Anatomicæ et Epist. Med. ex Schedis Posthumis. Hafniæ, 1664.